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A WATER QUALITY SURVEY, RED RIVER OF THE RIO GRANDE, NEW MEXICO

Robert S. Kerr Water Research Center
Ada, Oklahoma

January 1966

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A WATER QUALITY SURVEY

RED RIVER OF THE RIO GRANDE

NEW MEXICO

Prepared for

NEW MEXICO DEPARTMENT OF PUBLIC HEALTH

Santa Fe, New Mexico

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
ROBERT S. KERR WATER RESEARCH CENTER
ADA, OKLAHOMA

JANUARY 1966

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I. INTRODUCTION

Authority

In a letter dated September 24, 1965, the New Mexico Department of Public Health requested that the Robert S. Kerr Water Research Center ". . . perform a stream survey on the Red River of the Rio Grande to determine the present quality of the stream."

This study was made under the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.).

Purpose and Scope

The results of this stream survey will serve as water quality background information for the purpose of determining the extent of any water quality degradation that might come as a result of increased activity along the watershed of the Red River.

Historically, the drainage basin for the Red River has been a lightly populated, mountain resort area. Heavy industry has been absent from the basin. At present the most significant water users are an exploratory molybdenum mine and mill, a State fish hatchery, and a small amount of irrigation (800 acres).

In the near future Red River Basin activities are expected to intensify. Presently, a molybdenum mine, mill, and tailings pond are under construction. These operations, together with the people employed by the construction contractor and mining company, have the potential to incur a significant pollutional problem to the water resources of the basin.

Realizing that Red River Basin activities will intensify, the State of New Mexico desires to initiate a surveillance program for the area. This water quality survey will provide the necessary background for that program.

Acknowledgments

The cooperation of many people and several agencies was necessary in this study. The efforts of the following are especially appreciated:

New Mexico Department of Public Health
New Mexico Fish and Wildlife Department
United States Geological Survey

II. SUMMARY AND CONCLUSIONS

Summary

The New Mexico Department of Public Health requested the U. S. Public Health Service to conduct a water quality study on the Red River near Questa, New Mexico.

In accordance with this request, personnel from the Robert S. Kerr Water Research Center, assisted by State personnel, investigated seven major sampling stations and seven minor spring and well stations along the main stem of the Red River from above the town of Red River to below the State fish hatchery near Questa.

The facilities of the New Mexico State Public Health Laboratory in Albuquerque were used during the study where some 80 water samples were analyzed.

A field biological and bacteriological laboratory was set up at the State fish hatchery near Questa, New Mexico, where the samples from all major stations were assayed.

Basic water quality measurements were made at each sampling station on two-hour intervals for three 8-hour sample days and one 24-hour sample day. Measurements were made using portable instruments.

The river flow was gauged near each of the seven main stem stations by the U. S. Geological Survey during the period of investigation.

Conclusions

1. The chemical quality of the Red River water is exceptional. The water is suitable for a wide range of beneficial uses--domestic, industrial, and recreational, including the propagation of trout.

2. Microbiological quality of the river is generally good. Marginal fecal coliform pollution is indicated at Stations 2 and 7.

3. Biological conditions in the river are good. A biotic index of 11 or greater is indicated at all stations. A clean stream is described as a stream with a biotic index of 10 or greater.

4. Groundwater resources of the area are of high quality. Groundwater quality is comparable with the surface water, with the exception that total solids and chlorides are slightly higher.

5. The effect of even a small amount of untreated or inadequately treated waste would seriously degrade the water quality of the Red River due to its low average annual flow rate. Waste treatment must become a part of basin growth in order to preserve its high quality water. Surveillance of basic parameters at stations near the tailings pond and near Questa and Red River are desirable to detect water quality degradation as basin activities intensify.

III. DESCRIPTION OF THE PROJECT

Location

The project study area is located near Questa in North Central New Mexico, including 20 miles of the Red River from the State fish hatchery near Questa to above the town of Red River. (See location map designated Figure III-1 in back of this report.)

Seven major stream stations along the Red River, designated Stations 2 through 8, received intensive investigation. Seven other surface and groundwater stations off the main stem and in the vicinity of the tailings pond also were covered in the survey.

Sample stations were selected such that both present and potential water pollution load sources could be evaluated. These include the State fish hatchery, the molybdenum mill tailings pond, the town of Questa, the molybdenum mine and mill, the town of Red River, and mobile home camps scattered along the valley.

Characteristics of the Drainage Area

The drainage area of the Red River is mountainous and ranges in elevation from 13,151 feet at Wheeler Peak to 6,500 feet at the confluence with the Rio Grande. Most of the area is forested except for that part above timberline and the area on both sides of State Highway 3 north of the river. Part of the area each side of State Highway 3 is irrigated for crops and pasture. The forested and rocky nature of most of the drainage basin produces little fine material to contribute to the silt load of the stream. Landslides or construction activities may, however, contribute large quantities of silt from small areas.

The runoff from rainfall and snowmelt flows into the Red River via several small creeks with steep gradients. The distribution of summer rainfall and the slow melting of winter snows tend to prevent extremes of high or low flow in the river. The numerous springs and seeps tend to support a stable base flow throughout the year.

Total drainage area for the Red River is 190 square miles[1/]. Cabresto Creek, a major tributary to the Red River, has a drainage area of 36.3 square miles[1/].

The area is subject to a severe winter climate. Average mean rainfall is 21.22 inches[2/] (town of Red River); average mean temperature is 39.6°F[2/]. Elevation of the river bed varies from 8,600 feet at Station 8 to 7,100 feet at Station 2 (Figure III-1).

Geological Factors

The geology of the Red River area is such that low concentrations of dissolved material from natural sources occur in both streams and groundwater. The silt load in streams is generally low except for construction areas and areas of landslides or other unconsolidated silty material.

The survey area consists of a mountainous section east of Questa. A bajada (series of coalescing alluvial fans) broken by basalt flows lies west of the mountains.

The mountainous section is underlain by acidic igneous rocks (granite and rhyolite) and by metamorphic rocks. These rocks are generally hard but have been cut by deep, steep-walled canyons. Groundwater reservoirs are small, and movement through them is relatively rapid. These reservoirs consist of fractured and weathered zones in the hard rocks, and sand and gravel fill in the larger valleys. Because of the relatively insoluble nature of the rocks and the short retention time, water derived from this area is low in dissolved mineral matter. Although occasional landslides or construction activities contribute silt to the streams, the nature of the rocks normally precludes heavy silt loads.

Rocks west of the mountains have broken and moved downward with respect to the mountains. The lowland thus formed has been covered with detritus from the mountains and with basalt flows (lava) from centers on both sides of the Rio Grande. One of these centers (Guadalupe Mountain) is about two miles north of the State fish hatchery. (The lava from this center extends to about 3/4 mile west of the tailings pond and to a point south of the hatchery.) The lava flows and the detritus from the mountains interfinger but are predominantly lava west of a line extending north northeast 3/4 mile west of the tailings pond. East of that line and west of the mountain front the material underlying the surface and forming the floor and sides of the tailings pond consist of alluvial fans--unconsolidated, poorly-sorted, sands and gravels. Streams flowing over the alluvial fans may at times carry heavy loads of silt because of the loose nature of the material. Because the fans consist of relatively insoluble fragments of the older rocks in the mountains, the chemical load of water from the area north of Questa will be small except where it has been concentrated by evaporation and transpiration, or where there is a source of pollution.

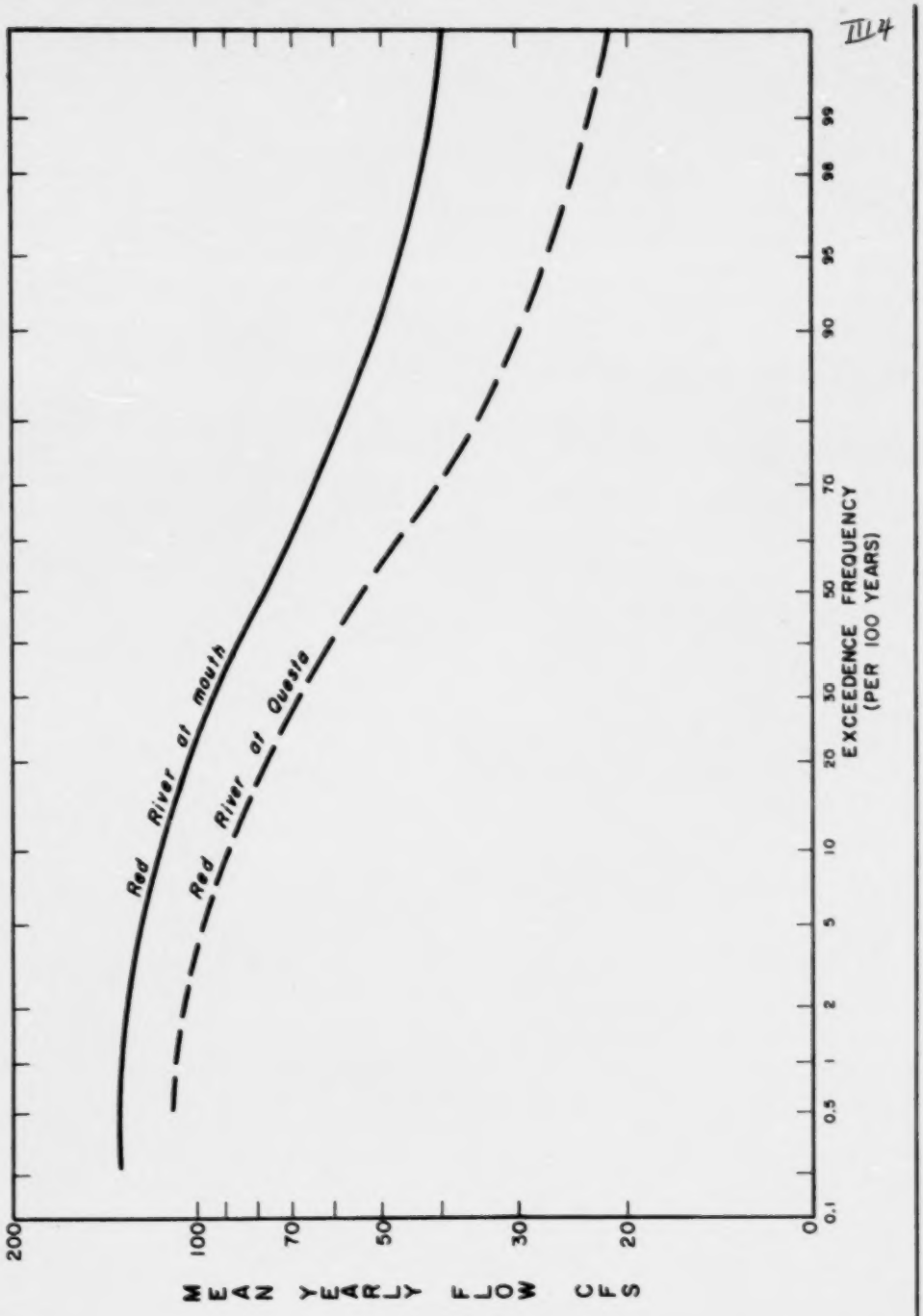
Water falling on the basalt flows west of the tailings pond will flow through cracks and joints in the rocks and through rubble zones between flows. Because of the rapid infiltration and movement into the lava and the lack of opportunity for extensive evapotranspiration, the waters are very low in dissolved solids as shown in the analyses.

Streamflow Characteristics

Streamflow of the Red River is stable. The flow record[1/] reveals an absence of extreme flows, both high and low. The river flow is seasonally influenced. Historical high flows occur in May as a result of melting snow. From May flows diminish to a low for the year, usually occurring during late fall and early winter. It is important to note that this survey was made during a month when low flows are experienced.

Figure III-2 illustrates the flow characteristics of the Red River. This flow frequency analysis reveals that the median yearly flow (50% point) for the Red River at the mouth is 85 CFS; for the Red River near Questa (Station 4) it is 55 CFS. The 5% point for the river at the mouth and near Questa shows a flow of 130 CFS and 95 CFS, respectively. This may be interpreted as meaning that from 100 years of record we would expect to find only five in which the mean yearly average flow equalled or exceeded 130 CFS and 95 CFS at these stations. At the other end of the graph (95% point) we may draw the conclusion that out of 100 years of record only five would be expected to be respectively 50 CFS and 25 CFS, or less for the Red River at its mouth and near Questa.

III-4



WATER QUALITY SURVEY
RED RIVER OF THE RIO GRANDE – NEW MEXICO

FLOW FREQUENCY ANALYSIS
RED RIVER AT MOUTH & NEAR QUESTA

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Federal Water Pollution Control Administration
ROBERT S. KERR WATER RESEARCH CENTER – ADA, OKLAHOMA

FIGURE III-2

IV. DESCRIPTION OF ANALYTICAL METHODS

Chemical Methods - Laboratory

The procedures outlined in Standard Methods for the Examination of Water and Wastewater, Twelfth Edition, 1965, were used for the chemical and physical analyses of the samples collected on this survey. Residue and turbidity analyses were by methods other than standard methods. The methods used for all analyses are described as follows:

1. BOD: Standard Methods, Twelfth Edition, 1965, p. 415. 300 ml. bottle dilution, no seed.

2. COD: Standard Methods, Twelfth Edition, 1965, p. 510.

3. Sulfate: Standard Methods, Twelfth Edition, 1965, p. 291, Turbidimetric Method.

4. Magnesium: By calculation difference of calcium concentration and the hardness in $CaCO_3$.

5. Iron: Standard Methods, Twelfth Edition, 1965, p. 159, Tripyridine Method.

6. Zinc: Standard Methods, Twelfth Edition, 1965, p. 317, Dithizone Method.

7. Chlorine: Standard Methods, Twelfth Edition, 1965, p. 87, Mercuric Nitrate Method.

8. Nitrate Nitrogen: Standard Methods, Twelfth Edition, 1965, p. 195, Phenoldisulfonic Acid Method.

9. Conductance: Micromhos direct reading with temp correction.

10. Turbidity: Hellige (turbidimeter).

11. Hardness: Standard Methods, Twelfth Edition, 1965, p. 147, EDTA Titrimetric Method.

12. pH: Standard Methods, Twelfth Edition, 1965, p. 226, Glass Electrode Method.

13. Residue: T.D.S. - Evaporated settled portion of sample.
S.S. - Filtered through membrane filter.
T.S. - Sum of T.D.S. and S.S.

14. Alkalinity: Standard Methods, Twelfth Edition, 1965, p. 48.

15. Temperature: Standard Methods, Twelfth Edition, 1965, p. 311.

16. Color: Hellige colorimeter.

17. Odor: Standard Methods, Twelfth Edition, 1965, p. 499.

18. Lead: Standard Methods, Twelfth Edition, 1965, p. 163.

Chemical Methods - Field

The chemical and physical determinations conducted in the field consisted of water temperature, conductivity, pH, and dissolved oxygen. Portable, battery operated instruments were transported to the sampling points, and the above determinations were made immediately after collecting the water sample.

Samples were taken and analyzed at the seven major sampling points on an 8-hour day basis, with four samples taken at 2-hour intervals. These four 2-hour samples were then composited and taken to the laboratory for more extensive analysis. One 24-hour sampling run was conducted with the samples collected at 2-hour intervals and composited in three 8-hour segments.

Chemical and Physical Measurements

Temperature - Each sample temperature was measured by use of a thermister attached to a Yellow Springs Instrument Company meter.

Conductivity - The conductivity was measured with an Industrial Instrument Model RB-338, portable, battery operated conductivity meter, using a VC-2, platinum coated, nickel electrode.

Dissolved Oxygen - The dissolved oxygen was measured with a Yellow Springs Instrument Company Model 51 Oxygen Meter in accordance with the manufacturer's operating instructions. Corrections were made for temperature and elevation.

pH - Measurements were made with a Sargent No. S-30007, Model PB, pH meter and an S-30072-15 combination electrode. The instrument was calibrated with buffers of pH four and seven prior to each sample run. Temperature adjustments were manually controlled.

Microbiological Methods

A field laboratory was established at the State fish hatchery, located southwest of Questa on the Red River. The procedures used were those found in the Twelfth Edition of Standard Methods for the Examination of Water and Wastewater, under the chapter entitled, "Tests for Presence of Members of Coliform Group by Membrane Filter Technique." Since the waters examined were not considered to be used as drinking waters, no parallel testing by multiple-tube fermentation technique was necessary.

To determine the presence of fecal streptococci, the membrane filter technique as described in Standard Methods as a tentative test was employed.

For enumeration of the fecal coliform group the membrane filter technique was used. Although this test has not been classified in Standard Methods, repeated testing by the Public Health Service and many State Health Departments, as well as university laboratories, has shown this test to be most reliable for the enumeration of the fecal coliform group.

Water samples were collected either in sterile, screw-capped glass bottles or widemouth, ground-glass, stoppered bottles. Immediately after collection, the bottles were placed in cooler chests until delivered to the laboratory. Samples were tested usually within one hour after collection with the exception of the last group of samples. These were transported from Questa to Albuquerque, under ice, and were examined within 24 hours after collection.

The medium used for the coliform test was M-Endo (Difco); for the fecal streptococcal test, M-enterococcus agar (Difco); and for the fecal coliform test, M-FC Broth (Difco) was used.

The samples were appropriately diluted in sterile phosphate buffered dilution water, and sterile dilution water was used for rinsing the funnel assembly between dilutions.

In order to sterilize the funnel assembly used in the procedures, a portable ultraviolet sterilizer was used as described by Rhines and Cheevers[3].

The total coliform and fecal streptococci culture dishes were incubated in a portable bacteriological water testing kit (Federal Stock No. 6665-682-4765), available from Millipore Filter Company. The incubator was allowed to stabilize for 24 hours before use.

The filter assembly consisted of a stainless steel filter holder inserted into a one-liter filtering flask which was attached to an electric vacuum pump. The membranes were 47 mm HA pre-sterilized having a grid-marked surface. Culture dishes were of the sterile, disposable type capable of accomodating the 47 mm filter membrane. The snap-type dish was used in order to allow for a greater number of samples to be incubated.

The last group of samples to be tested were taken to the New Mexico State Public Health Laboratory in Albuquerque. The same procedures were employed as used at the fish hatchery. The fecal coliform test was run on the last group of samples since the State laboratory had a 44.5°C water bath necessary for the differentiation of the fecal coliform group.

Biological Methods

Biological sampling stations were the same as those used for the collection of chemical samples except for the addition of Station 2-A above the Red River State fish hatchery. Since the stream bottom was rocky, a Surber square-foot sampler was used at all sampling locations. One square-foot sample was collected from Station T and two square-foot samples were collected from Station 2-A. Three square-foot samples were collected from each of the other stations. Date, water temperature, and bottom type were observed and recorded at the time samples for benthic macro-invertebrates were collected. All samples were sorted by the sugar floatation technique of Anderson[47].

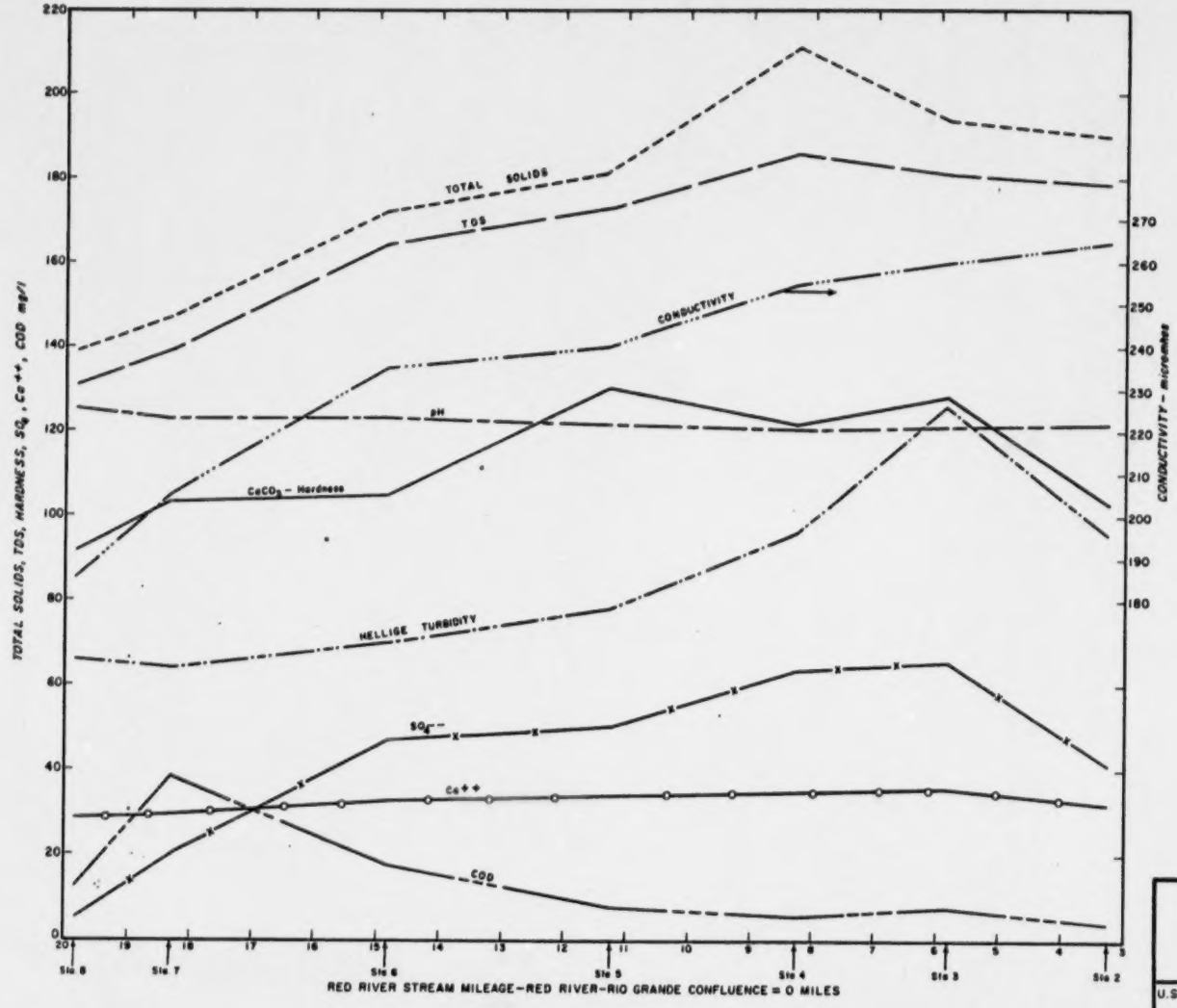
V. PRESENTATION OF DATA

Chemical Quality

A chemical analysis of the water from all survey stations in the Red River Basin indicates that the water is of exceptional quality. All chemical constituents analyzed were well within the U. S. Public Health Service drinking water standards for raw water supply.

Figure V-1 illustrates the variation of the more significant chemical parameters between sampling points. Sample station numbers have been located at their respective stream mileage for convenience. It can be seen from the graph that there is little variation in the parameters as the stream traverses its course. The most significant variation is in total dissolved solids, sulfates, conductivity, and turbidity. These are shown to increase moderately from Station 8 through Station 3. The slight improvement in quality between Station 3 and Station 2 is indicative of the dilutional effect of the waters from the springs which enter the river between these two stations. Also entering the Red River between Stations 2 and 3 is the effluent from the State fish hatchery. Fresh water supply for the fish hatchery comes via pipeline from springs just below Station 3 and is discharged to the river above Station 2.

Table V-1 is a water quality summary sheet which lists the averages for each station for comparison. Tables V-2 through V-8 list the complete chemical analysis of all stations sampled throughout the survey.



WATER QUALITY SURVEY
RED RIVER OF THE RIO GRANDE–NEW MEXICO

WATER QUALITY AT MAJOR SAMPLE POINTS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Federal Water Pollution Control Administration
ROBERT S. KERR WATER RESEARCH CENTER – ADA, OKLAHOMA

FIGURE V-1

TABLE V-1
WATER QUALITY SUMMARY SHEET

	STATION #8	STATION #7	STATION #6	STATION #5	STATION #4	STATION #3	STATION #2
CHEMICAL ANALYSES							
CONDUCTIVITY, micromhos	185	205	235	240	255	260	265
pH	8.5	8.3	8.3	8.2	8.1	8.1	8.2
DISSOLVED OXYGEN, ppm	8.7	8.8	9.1	9.2	9.2	9.1	8.5
PERCENT OXYGEN SATURATION	93	96	95	95	95	95	98
TURBIDITY, turbidity units	2.6	2.4	3	3.8	5.6	8.6	5.6
COLOR, color units	<5	<5	<5	<5	<5	<5	<5
ODOR, threshold no.	1	1	1	1	1	1	1
B.O.D., mg/l	1.6	1.2	1.7	1.4	1.6	1.8	1.7
C.O.D., mg/l	12.2	38.7	17.8	7.9	5.5	7.1	3.9
TOTAL DISSOLVED SOLIDS, mg/l	130	139	164	173	186	181	179
SUSPENDED SOLIDS, mg/l	8	8	8	8	25	13	11
TOTAL SOLIDS, mg/l	138	147	172	181	211	194	190
ALKALINITY as $CaCO_3$, mg/l	79.4	73.7	62.1	60.4	56.3	57.4	74.6
Cl^-, mg/l	.6	1.6	1.2	1.7	1.3	1.3	4.8
SO_4^{--}, mg/l	5.3	20.3	46.8	50.5	63.5	65.5	41.9
Ca^{++}, mg/l	28.9	29.8	32.5	33.4	34.4	35.7	32
Mg^{++}, mg/l	4.9	7.4	5.8	11.5	9	9.7	6.6
Fe^{+++}, mg/l	<.02	<.02	<.02	<.02	<.02	<.02	<.02
NO_3^-, mg/l	<1	<1	<1	<1	<1	<1	<1
As, mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l	<.02	<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l	<1	<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l	91.3	103.3	105	130	121.7	128.3	103.3

TABLE V-2
CHEMICAL QUALITY - STATION NO. 2*

	Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
	Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES							
TEMPERATURE, °C		10.8	9.0	9.5	7.0	9.0	8.5
CONDUCTIVITY, micromhos		265	275	265	265	275	265
pH		8.4	8.1	8.3	8.4	8.2	8.0
DISSOLVED OXYGEN, ppm		8.2	8.1	8.3	9.0	8.6	8.7
PERCENT OXYGEN SATURATION		99	93	97	99	99	99
LABORATORY ANALYSES							
TEMPERATURE, °C		24	22.5	23	24	19.5	
CONDUCTIVITY, micromhos		255	256	258	265	264	
pH		7.9	7.8	7.8	7.7	7.5	
TURBIDITY, turbidity units		9.5	4	5.1	5.6	4	
COLOR, color units		<5	<5	<5	<5	<5	
ODOR, threshold no.		1	1	1	1	1	
B.O.D., mg/l		1.6	1.7	2.3	1.1	1.5	1.8
C.O.D., mg/l		11.6	0.0	0.0	7.9	0.0	
TOTAL DISSOLVED SOLIDS, mg/l		180	180	185	170		
SUSPENDED SOLIDS, mg/l		15	10	10	8		
TOTAL SOLIDS, mg/l		195	190	195	178		
ALKALINITY as $CaCO_3$, mg/l		75.2	73	72.5	72.5	79.6	
Cl^-, mg/l		5	4.5	5	4.5	5	
SO_4^{--}, mg/l		43	40	42.5	42		
Ca^{++}, mg/l		30.4	32.8	30.4	34.4		
Mg^{++} mg/l		7.1	6.8	5.9			
Fe^{+++}, mg/l		<.02	<.02	<.02	<.02	<.02	
NO_3^-, mg/l		<1	<1	<1	<1		
As, mg/l		<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l		<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l		<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l		100	110	100			

*Located below State fish hatchery - Elevation 7,100'

TABLE V-3
CHEMICAL QUALITY - STATION NO. 3*

	Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
	Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES							
TEMPERATURE, °C		7.0	5.3	5.3	2.3	5.8	4.1
CONDUCTIVITY, micromhos		265	265	260	265	260	255
pH		8.2	7.8	8.5	8.4	7.9	7.7
DISSOLVED OXYGEN, ppm		8.4	8.8	9.1	9.9	8.9	9.3
PERCENT OXYGEN SATURATION		92	93	97	97	96	96
LABORATORY ANALYSES							
TEMPERATURE, °C		23.5	22.5	23	24	19.5	
CONDUCTIVITY, micromhos		258	259	255	265	266	
pH		7.4	7.4	7.5	7.4	7.8	
TURBIDITY, turbidity units		11	6.8	12.9	8.1	4	
COLOR, color units		<5	<5	<5	<5	<5	
ODOR, threshold no.		1	1	1	1	1	
B.O.D., mg/l		1.6	2.0	1.8	0.5	1.4	2.2
C.O.D., mg/l		19.7	3.9	3.9	7.9		
TOTAL DISSOLVED SOLIDS, mg/l		190	170	190	175		
SUSPENDED SOLIDS, mg/l		20	9	15	9		
TOTAL SOLIDS, mg/l		210	179	205	184		
ALKALINITY as $CaCO_3$, mg/l		59	55.6	55.6	61	55.6	
Cl^-, mg/l		.5	1.5	1.5	1	2	
SO_4^{--}, mg/l		65	65	68	64		
Ca^{++}, mg/l		35.2	36	35.2	35.2	36.8	
Mg^{++}, mg/l		10.2	9.8	9			
Fe^{+++}, mg/l		<.02	<.02	<.02	<.02	<.02	
NO_3, mg/l		<1	<1	<1	<1		
As, mg/l		<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l		<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l		<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l		130	130	125			

*Located below town of Questa - Elevation 7,300'

TABLE V-4
CHEMICAL QUALITY - STATION NO. 4*

	Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
	Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES							
TEMPERATURE, °C		5.0	4.0	4.5	2.3	3.8	3.0
CONDUCTIVITY, micromhos		255	260	260	255	250	250
pH		7.9	8.0	8.5	8.4	7.8	7.8
DISSOLVED OXYGEN, ppm		8.4	9.1	9.0	10	9.2	9.7
PERCENT OXYGEN SATURATION		88	95	94	98	95	97
LABORATORY ANALYSES							
TEMPERATURE, °C		24	22	22.5	24	19.5	
CONDUCTIVITY, micromhos		242	253	262	253	266	
pH		7.6	7.5	7.5	7.5	7.6	
TURBIDITY, turbidity units		5	4.3	5.9	8.7	4	
COLOR, color units		<5	<5	<5	<5	<5	
ODOR, threshold no.		1	1	1	1	1	
B.O.D., mg/l		1.5	1.9	1.7	1.7	1.5	1.7
C.O.D., mg/l		15.8	3.9	3.9	3.9		
TOTAL DISSOLVED SOLIDS, mg/l		180	195	200	170		
SUSPENDED SOLIDS, mg/l		8	8	78	8		
TOTAL SOLIDS, mg/l		188	203	278	178		
ALKALINITY as $CaCO_3$, mg/l		57.9	55	58.9	54.5	55	
Cl^-, mg/l		1.	1.5	.5	1.5	2	
SO_4^{--}, mg/l		62	63	67	62		
Ca^{++}, mg/l		33	34.4	34.4	34	36	
Mg^{++}, mg/l		9.3	8.3	9.5			
Fe^{+++}, mg/l		<.02	<.02	<.02	<.02	<.02	
NO_3^-, mg/l		<1	<1	<1	<1	<1	
As, mg/l		<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l		<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l		<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l		120	120	125			

*Located above town of Questa - Elevation 7,444'

TABLE V-5
CHEMICAL QUALITY - STATION NO. 5*

	Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
	Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES							
TEMPERATURE, °C		4.0	3.5	3.5	1.4	3.3	2.4
CONDUCTIVITY, micromhos		240	240	240	240	250	225
pH		8	8.4	8.4	8.8	7.9	7.9
DISSOLVED OXYGEN, ppm		8.4	9.1	9.3	10.1	8.9	9.2
PERCENT OXYGEN SATURATION		89	96	97	100	93	94
LABORATORY ANALYSES							
TEMPERATURE, °C		23.5	22	22.5	24	19.5	
CONDUCTIVITY, micromhos		240	239	249	240	250	
pH		7.5	7.5	7.4	7.3	7.4	
TURBIDITY, turbidity units		3	4	4.5	3.5	4	
COLOR, color units		<5	<5	<5	<5	<5	
ODOR, threshold no.		1	1	1	1	1	
B.O.D., mg/l		1.5	1.6	1.9	1.6	1.5	1.2
C.O.D., mg/l		15.8	13.8	3.9	5.9		
TOTAL DISSOLVED SOLIDS, mg/l		110	150	260	170		
SUSPENDED SOLIDS, mg/l		8	8	8	8		
TOTAL SOLIDS, mg/l		118	158	268	178		
ALKALINITY as $CaCO_3$, mg/l		63	60	58.9	60	60	
Cl^-, mg/l		1.7	2	2	1.5	1.5	
SO_4^{--}, mg/l		48	51	54	49		
Ca^{++}, mg/l		32	34.4	33.6	32.8	34.4	
Mg^{++}, mg/l		15.9	12	6.6			
Fe^{+++}, mg/l		<.02	<.02	<.02	<.02	<.02	
NO_3^-, mg/l		<1	<1	<1	<1		
As, mg/l		<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l		<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l		<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l		145	135	110			

*Located below molybdenum mill - Elevation 8,000'

TABLE V-6
CHEMICAL QUALITY - STATION NO. 6*

Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES						
TEMPERATURE, °C	4	3.5	4	1.3	3	2.3
CONDUCTIVITY, micromhos	220	235	240	230	240	220
pH	8.1	8.5	8.6	8.8	7.9	7.9
DISSOLVED OXYGEN, ppm	8.2	9	9.2	10	8.9	9.2
PERCENT OXYGEN SATURATION	87	95	99	99	93	94
LABORATORY ANALYSES						
TEMPERATURE, °C	23.5	22	22.5	24	19.5	
CONDUCTIVITY, micromhos	235	243	239	230	239	
pH	8	7.5	7.4	7.4	7.4	
TURBIDITY, turbidity units	4	2.6	2.1	2.1	4	
COLOR, color units	<5	<5	<5	<5	<5	
B.O.D., mg/l	1.8	1.5		1.2	1.7	1.6
C.O.D., mg/l	13.8	23.7	19.7	15.8	15.8	
TOTAL DISSOLVED SOLIDS, mg/l	160	150	170	175		
SUSPENDED SOLIDS, mg/l	8	8	8	8		
TOTAL SOLIDS, mg/l	168	158	178	183		
ALKALINITY as $CaCO_3$, mg/l	64	61	62	62	61.6	
Cl^-, mg/l	.5	2	1.5	1	1.2	
SO_4^{--}, mg/l	45	48	49	45		
Ca^{++}, mg/l	32	32.8	32	32.8	32.8	
Mg^{++} mg/l	2.4	8	7			
Fe^{+++}, mg/l	<.02	<.02	<.02	<.02	<.02	
NO_3^-, mg/l	<1	<1	<1	<1		
As, mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l	<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l	<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l	90	115	110			

*Located above molybdenum mill - Elevation 8,200'

TABLE V-7
CHEMICAL QUALITY - STATION NO. 7*

	Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
	Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES							
TEMPERATURE, °C		5	5	3.3	1.3	4.6	4.3
CONDUCTIVITY, micromhos		205	210	200	200	215	200
pH		8.1	8.3	8.7	8.7	7.9	7.9
DISSOLVED OXYGEN, ppm		8.4	8.5	8.9	9.3	8.7	8.7
PERCENT OXYGEN SATURATION		94	96	96	95	97	96
LABORATORY ANALYSES							
TEMPERATURE, °C		23.5	21.5	22.5	24	19.5	
CONDUCTIVITY, micromhos		208	210	201	205	214	
pH		7.7	7.5	7.4	7.4	7.4	
TURBIDITY, turbidity units		2	1.4	2.8	1.6	4	
COLOR, color units		<5	<5	<5	<5	<5	
ODOR, threshold no.		1	1	1	1	1	
B.O.D., mg/l		1.4	1.5	1.2	.98	1.2	1.2
C.O.D., mg/l		15.8	51.3	35.5	82.9	7.9	
TOTAL DISSOLVED SOLIDS, mg/l		140	140	140	135		
SUSPENDED SOLIDS, mg/l		8	8	8	8		
TOTAL SOLIDS, mg/l		148	148	148	143		
ALKALINITY as $CaCO_3$, mg/l		85	70.9	70.9	70.9	70.9	
Cl^-, mg/l		2.5	1.5	1	1.5	1.3	
SO_4^{--}, mg/l		20	18	22	21		
Ca^{++}, mg/l		28.8	29.6	31.2	29.6	29.6	
Mg^{++}, mg/l		9.2	7.6	5.4			
Fe^{+++}, mg/l		<.02	<.02	<.02	<.02	<.02	
NO_3^-, mg/l		<1	<1	<1	<1		
As, mg/l		<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l		<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l		<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l		105	105	100			

*Located below town of Red River - Elevation 8,680'

TABLE V-8
CHEMICAL QUALITY - STATION NO. 8*

	Date :	11-3-65	11-4-65	11-4-65	11-4-65	11-7-65	11-8-65
	Run No.:	1	2-a	2-b	2-c	3	4
FIELD ANALYSES							
TEMPERATURE, °C		3.5	3	3	1	3	2.4
CONDUCTIVITY, micromhos		180	180	180		190	180
pH		8.5	8.9	8.9	9	7.9	7.9
DISSOLVED OXYGEN, ppm		8.2	8.6	8.9	9.5	8.5	8.8
PERCENT OXYGEN SATURATION		89	92	96	97	91	93
LABORATORY ANALYSES							
TEMPERATURE, °C		23.5	21.5	22.5	24	19.5	
CONDUCTIVITY, micromhos		185	188	183	187	186	
pH		8.1	7.8	7.7	7.6	8.15	
TURBIDITY, turbidity units		4	.8	2.3	2.1	4	
COLOR, color units		<5	<5	<5	<5	<5	
ODOR, threshold no.		1	1	1	1	1	
B.O.D., mg/l		1.7	1.8	1.6	1.5	1.1	2.1
C.O.D., mg/l		13.8	15.8	3.9	23.7	3.9	
TOTAL DISSOLVED SOLIDS, mg/l		120	130	140	130		
SUSPENDED SOLIDS, mg/l		8	8	8	8		
TOTAL SOLIDS, mg/l		128	138	148	138		
ALKALINITY as $CaCO_3$, mg/l		82	77.4	78.5	79.6	79.6	
Cl^-, mg/l		.5			1	1.5	
SO_4^{--}, mg/l		5	6	5	5		
Ca^{++}, mg/l		28.8	28.4	28.8	29.6	28.8	
Mg^{++}, mg/l		5.6	4.9	4.4	4.6		
Fe^{+++}, mg/l		<.02	<.02	<.02	<.02	<.02	
NO_3^-, mg/l		.09	<1	<1	<1		
As, mg/l		<.01	<.01	<.01	<.01	<.01	<.01
Pb, mg/l		<.02	<.02	<.02	<.02	<.02	<.02
Zn, mg/l		<1	<1	<1	<1	<1	<1
HARDNESS as $CaCO_3$, mg/l		95	90	90	90		

*Located above town of Red River - Elevation 8,700'

Microbiological Quality

Based upon the parameters used and the limited number of samples tested, the data indicate that the microbiological quality was suitable for recreational uses and as a raw water supply. Of the seven sampling stations, only two, Stations 2 and 7, showed what may be considered high coliform counts. Sampling points, Station 2 located directly below the fish hatchery and Station 7 just below the town of Red River, gave average coliform counts of 770 coliforms/100 ml and 1800/100 ml, respectively. Station 3 had an average of 176/100 ml. Stations 4, 5, and 6 had averages of 131, 304, and 280/100 ml, respectively. Counts of less than 100/100 ml were observed only from Station 8 where the count averaged 4/100 ml. The coliform count at this station ranged from 2 to 6/100 ml.

It is apparent that both the town of Red River and the fish hatchery are contributing some pollution to the Red River. The amount, however, remains quite small. The results of both the fecal coliform test and the fecal streptococci test indicate an insignificant amount of pollution. Station 7 showed only 20 fecal coliforms/100 ml and less than two fecal streptococci/100 ml. Station 2 had the highest fecal streptococci count with 74/100 ml but only four fecal coliforms/100 ml.

These data indicate that the type of pollution emanating from the town of Red River was more of the human type, whereas that stemming from the fish hatchery was more of the animal type. It is very doubtful if the fish are contributing to either the fecal coliform or fecal streptococci count, although perhaps further testing would be desirable.

Bacteriological results for all stations are presented in Table V-9.

TABLE V-9
BACTERIOLOGICAL RESULTS
(MEMBRANE FILTER)

DATE AND ANALYSIS	STATION #8	STATION #7	STATION #6	STATION #5	STATION #4	STATION #3	STATION #2
11-4-65:							
TOTAL COLIFORM/100 ml.	6	410	280	240	121	170	760
TOTAL COLIFORM/100 ml.	3	2500	360	280	129	170	900
11-6-65:							
TOTAL COLIFORM/100 ml.	4	4000	290	680	270	270	800
11-7-65:							
TOTAL COLIFORM/100 ml.	2	290	30	10	5	95	650
FECAL COLIFORM/100 ml.	<1	50	<2	2	4	24	4
FECAL STREPTOCOCCI/100 ml.	1	<2	<2	2	2	30	74

Biological Quality

Relative percentages of organism types and the "Biotic Index" are presented for each biological sampling station (Table V-10). Benthic macroinvertebrates are grouped as clean-water, facultative, and pollutional. Surber[5], who used this grouping of organism types, states that probably ". . . only the use of 'facultative' requires explanation: facultative animals are those forms that are able to live in fairly heavily-polluted areas as well as in clean water situations." The biotic index used by Beck[6] expresses biotic conditions as a single number. Index values of 10 or greater always indicate a clean stream. A grossly polluted stream will always have an index of zero, and a moderately polluted stream will have a biotic index of one to six. A clean stream may rarely have an index which ranges from four to nine if characterized by a monotonous habitat and low velocity.

Based on observation and evaluation of data including the biotic index described by Beck[6] the effects of organic pollution on populations of benthic organisms have been used to classify the biological sampling stations. The water is clean at all stations sampled in the study area.

A biological summary is presented in Table V-10 in which all stations are grouped together for comparison. A more detailed analysis is given for each station in Tables V-11 through V-19.

TABLE V-10
BIOLOGICAL CONDITIONS AT THE SAMPLING STATIONS IN THE STUDY AREA

Sampling Station	Number of Square-foot Samples	Percent			Biotic Index	No. of Species	No. of Organisms
		Clean	Facultative	Pollutional			
T	1	100	0	0	14	7	15
2	3	75	15	10	33	20	96
2-A	2	90	10	0	19	10	54
3	3	83	17	0	11	6	30
4	3	89	11	0	17	9	23
5	3	93	7	0	27	14	112
6	3	94	6	0	33	17	94
7	3	95	5	0	39	20	353
8	3	91	9	0	42	22	291

TABLE V-11
BIOLOGICAL DATA

Station No.: T
Number of Square-foot Samples: 1
Date: November 3, 1965
Water Temperature: 11° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	Total No.
Ephemeroptera			
Baetis sp.	Clean	4	4
Rhithrogena sp.	Clean	1	1
Plecoptera			
Pteronarella sp.	Clean	1	1
Arcynopteryx sp.	Clean	1	1
Diptera			
Spaniotoma sp.	Clean	2	2
Hemiptera			
Merragata sp.	Clean	5	5
Rheumatobates sp.	Clean	1	1
			TOTAL 15

TABLE V-12
BIOLOGICAL DATA

Station No.: 2
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 7°C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Baetis sp.	Clean	3	4	7	14
Rhithrogena sp.	Clean	3	4	1	8
Ephemerella sp.2	Clean	1	0	2	3
Dolania sp.	Clean	0	0	1	1
Plecoptera					
Pteronarella sp.	Clean	2	4	0	6
Trichoptera					
Hydropsyche sp.	Clean	3	2	8	13
Athripsodes sp.	Clean	5	5	1	11
Rhyacophila sp.2	Clean	1	0	3	4
Agapetus sp.	Clean	0	0	2	2
Rhyacophila sp.3	Clean	0	1	0	1
Diptera					
Spaniotoma sp.	Clean	0	4	2	6
Calopsectra sp.	Clean	0	6	0	6
Tipula sp.	Facultative	1	2	0	3
Atherix sp.	Clean	0	1	0	1
Coleoptera					
Stenelmis sp.	Facultative	0	0	1	1
Hemiptera					
Microvelia sp.	Clean	0	0	1	1
Gastropoda					
Physa sp.	Pollutional	2	2	1	5
Turbellaria					
Dugesia tigrina	Clean	6	1	0	7
Oligachaeta					
One species	Facultative	0	1	0	1
Pelecypoda					
Pisidium sp.	Pollutional	2	0	0	2
				TOTAL	96

TABLE V-13
BIOLOGICAL DATA

Station No.: 2-A
Number of Square-foot Samples: 2
Date: November 3, 1965
Water Temperature: 10° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	No. in Sample #2	Total No.
Ephemeroptera				
Baetis sp.	Clean	3	9	12
Rhithrogena sp.	Clean	1	0	1
Ephemerella sp.$_2$	Clean	0	1	1
Trichoptera				
Hydropsyche sp.	Clean	1	2	3
Athripsodes sp.	Clean	1	1	2
Diptera				
Spanitoma sp.	Clean	8	13	21
Calopsectra sp.	Clean	2	7	9
Atherix sp.	Clean	0	1	1
Coleoptera				
Stenelmis sp.	Facultative	1	2	3
Hemiptera				
Mesovelia mulsanti	Clean	1	0	1

TABLE V-14
BIOLOGICAL DATA

Station No.: 3
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 4° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Ephemerella sp.2	Clean	3	3	2	8
Baetis sp.	Clean	2	1	0	3
Rhithrogena sp.	Clean	0	0	2	2
Plecoptera					
Pteronarella sp.	Clean	2	9	1	12
Diptera					
Atherix sp.	Clean	0	0	2	2
Coleoptera					
Stenelmis sp.	Facultative	0	1	2	3
					TOTAL 30

TABLE V-15
BIOLOGICAL DATA

Station No.: 4
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 3° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Rhithrogena sp.	Clean	2	1	0	3
Baetis sp.	Clean	0	1	0	1
Ephemerella sp.$_2$	Clean	0	0	1	1
Plecoptera					
Pteronarella sp.	Clean	1	1	7	9
Brachyptera sp.	Clean	1	2	1	3
Brachyptera sp.$_2$	Clean	0	0	1	1
Coleoptera					
Stenelmis sp.	Facultative	0	0	1	1
Hemiptera					
Mesovelia mulsanti	Clean	0	1	2	3
Microvelia sp.	Clean	0	1	0	1
					TOTAL 23

TABLE V-16
BIOLOGICAL DATA

Station No.: 5
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 3° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Rhithrogena sp.	Clean	15	34	20	69
Ephemerella sp.$_2$	Clean	0	7	2	9
Baetis sp.	Clean	2	1	1	4
Plecoptera					
Pteronarella sp.	Clean	0	2	1	3
Brachyptera sp.	Clean	0	2	1	3
Brachyptera sp.$_3$	Clean	0	0	1	1
Arcynopteryx sp.	Clean	0	1	0	1
Trichoptera					
Arctopsyche sp.	Clean	0	0	1	1
Athripsodes sp.	Clean	0	0	1	1
Rhyacophila sp.$_3$	Clean	1	0	0	1
Diptera					
Calopsectra sp.	Clean	3	2	4	9
Spaniotoma sp.	Clean	0	0	4	4
Atherix sp.	Clean	0	1	2	3
Coleoptera					
Stenelmis sp.	Facultative	1	1	1	3
				TOTAL	112

TABLE V-17
BIOLOGICAL DATA

Station No.: 6
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 3° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Ephemerella sp.$_2$	Clean	0	9	2	11
Baetis sp.	Clean	0	1	3	4
Rhithrogena sp.	Clean	1	5	1	2
Ephemerella sp.	Clean	0	0	1	1
Plecoptera					
Pteronarella sp.	Clean	1	8	0	9
Arcynopteryx sp.	Clean	1	1	0	2
Brachyptera sp.$_2$	Clean	0	2	0	2
Capnia sp.	Clean	0	1	0	1
Trichoptera					
Athripsodes sp.	Clean	2	4	4	10
Agapetus sp.	Clean	0	3	2	5
Rhyacophila sp.$_2$	Clean	0	2	2	4
Arctopsyche sp.	Clean	0	1	0	1
Diptera					
Spaniotoma sp.	Clean	1	2	6	9
Atherix sp.	Clean	0	4	0	4
Coleoptera					
Stenelmis sp.	Facultative	3	17	7	27
Hemiptera					
Mesovelia mulsanti	Clean	1	0	2	3
Collembola					
Isotomurus palustris	Clean	0	0	1	1
				TOTAL	94

TABLE V-18
BIOLOGICAL DATA

Station No.: 7
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 7° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Rhithrogena sp.	Clean	57	31	43	131
Ephemerella sp.$_2$	Clean	10	21	19	50
Ephemerella sp.	Clean	6	2	8	16
Dolania sp.	Clean	4	6	2	12
Baetis sp.	Clean	3	0	4	7
Caenis sp.	Clean	0	1	0	1
Plecoptera					
Pteronarella sp.	Clean	9	21	10	40
Arcynopteryx sp.	Clean	3	3	1	7
Diura knowltoni	Clean	0	0	3	3
Claassenia sp.	Clean	1	0	0	1
Isoperla sp.	Clean	1	0	0	1
Brachyptera sp.$_2$	Clean	0	0	1	1
Trichoptera					
Arctopsyche sp.	Clean	9	12	6	27
Agapetus sp.	Clean	2	17	2	21
Athripsodes sp.	Clean	2	2	5	9
Hydropsyche sp.	Clean	3	2	0	5
Polycentropus sp.	Clean	0	1	0	1
Rhyacophila sp.	Clean	1	0	0	1
Diptera					
Atherix sp.	Clean	0	2	1	1
Coleoptera					
Stenelmis sp.	Facultative	3	6	9	18
				TOTAL	353

TABLE V-19
BIOLOGICAL DATA

Station No.: 8
Number of Square-foot Samples: 3
Date: November 3, 1965
Water Temperature: 4° C
Bottom Type: Rocky

Organism	Type	No. in Sample #1	#2	#3	Total No.
Ephemeroptera					
Rhithrogena sp.	Clean	39	23	36	98
Ephemerella sp.	Clean	14	17	14	45
Dolania sp.	Clean	11	2	16	29
Baetis sp.	Clean	6	8	5	19
Plecoptera					
Brachyptera sp.	Clean	7	5	1	13
Hastaperla sp.	Clean	0	5	3	8
Arcynopteryx sp.	Clean	6	0	0	6
Nemoura sp.	Clean	2	0	1	3
Acroneuria sp.	Clean	2	0	0	2
Nemoura sp.$_2$	Clean	0	0	1	1
Trichoptera					
Arctopsyche sp.	Clean	7	11	16	34
Rhyacophila sp.$_2$	Clean	7	1	1	9
Rhyacophila sp.	Clean	1	1	0	2
Rhyacophila sp.$_3$	Clean	0	2	0	2
Agapetus sp.	Clean	0	1	1	2
Athripsodes sp.	Clean	0	1	0	1
Hydropsyche sp.	Clean	0	1	0	1
Diptera					
Spaniotoma sp.	Clean	1	2	1	4
Chaoborus albipes	Clean	0	4	0	4
Pericoma sp.	Clean	0	1	1	2
Prionocera sp.	Facultative	0	0	1	1
Coleoptera					
Stenelmis sp.	Facultative	3	0	2	5
				TOTAL	291

Groundwater Characteristics

Groundwater east of Questa was not sampled, however, it is low in dissolved solids[2/] except where there are local sources of pollution. Water in the sand and gravel along Red River will be of a quality similar to the river water but will not fluctuate as widely during the year as does river water, and turbidity will be lower for the groundwater.

Water in the shallow alluvial sand and gravels along the river between Cabresto Creek and the tailings pond is similar to the river water at Station 3 as shown by the analysis of spring 28-12-1-141. The groundwater TDS is slightly more concentrated because of evapotranspiration in the meadows where the water table is shallow. This is probably the cause of the similar type, but slightly higher concentration in spring 29-12-2-244 and well 29-12-1-131, both located along the north valley wall below the tailings pond.

Water flowing from the tailings pond at the time of the survey was reported to be a combination of groundwater and irrigation return flow from the area east of the pond. Because of the seasonal distribution of irrigation and precipitation, this water may be expected to vary in quality with time of year.

Water from springs in the canyon within about one mile above the State fish hatchery is from recharge of the groundwater body in the basalt flows and is similar in quality to that at Station 8. The quality of this water flowing into the river between Station 3 and Station 2 is responsible for the improvement in chemical quality between those stations.

Table V-20 gives a description of all groundwater sampling points used in the survey. This is followed by Table V-21 which gives the chemical analysis for the samples collected from these points.

TABLE V-20

DESCRIPTION OF GROUNDWATER SAMPLING POINTS

Designation in Sample Analyses	Owner	Use	Location	Aquifer
Well 28-12-1-131	Alfred Duran	Domestic	T28N, R12E, Sec. 1, NW/4 SW/4 NW/4, 2700 feet SW of tailings pond.	Alluvium
Spring 28-12-1-141	State of New Mexico	Fish Hatchery	T27N, R12E, Sec. 1, NW/4 SE/4 NW/4, 2500 feet SE of tailings pond.	Alluvium
Spring 28-12-2-241	Unknown	Stock	T28N, R12E, Sec. 2, SE/4 SE/4 NE/4, 2900 feet SW of tailings pond.	Alluvium or Basalt
Spring 28-12-2-311	State of New Mexico	None	T28N, R12E, Sec. 2, NW/4 NW/4 SW/4 1/2 mile upstream from Fish Hatchery.	Basalt
Spring 28-12-3-400	State of New Mexico	Fish Hatchery	T28N, R12E, Sec. 3, SE/4 in canyon above Fish Hatchery	Basalt
Spring 28-12-3-420	State of New Mexico	Fish Hatchery	T28N,R12E, Sec. 3, NE/4 SE/4 in canyon above Fish Hatchery.	Basalt
Tailings Pond	Molybdenum Corporation of America	None	T28N, R12E, Sec. 1, NW/4 NW/4 Sampling point at access road and drainage ditch from pond.	Santa Fe Group

TABLE V-21
GROUNDWATER ANALYSES

CHEMICAL ANALYSES	Spring 28-12-2-311	Spring 28-12-3-420	Spring 28-12-3-400	Well 28-12-1-131	Spring 28-12-2-244	Spring 28-12-1-141	Tailings Pond (T)	Spring** 28-12-3
CONDUCTIVITY, micromhos	270	283	283	450	470	390	425	229
pH	7.95	7.95	7.8	7.5	7.5	7.15	8.3	7.8
TURBIDITY, units	1.6	1.6	1.6	1.6	1.6	1.6	10.8	
COLOR, units	<5	<5	<5	<5	<5	<5	<5	
ODOR	1	1	1	1	1	1	1	
B.O.D., mg/1							1	
C.O.D., mg/1	3.9	11.8	3.9	90.9	15.8	7.9	21.7	
HARDNESS as $CaCO_3$	145	135	80	225	230	250	190	65
ALKALINITY as $CaCO_3$, mg/1	85	85	86	170	172	133	162.5	
TOTAL DISSOLVED SOLIDS, mg/1	275	150	160	285	300	255	280	155
SUSPENDED SOLIDS, mg/1	10	<8	<8	<8	46	<8	312*	
TOTAL SOLIDS, mg/1	285	158	168	293	346	263	592*	
Ca^{++}, mg/1	13.6	15.2	15.2	64.8	65.6	55.2	47.6	19
Mg^{++}, mg/1	27	23.6	10.2	15.3	16.1	27.2	23	4.3
Na tK, mg/1								24
Fe^{+++}, mg/1	<.02	<.02	<.02	<.02	<.02	<.02	7.9	
HCO_3^-, mg/1								103
Cl^-, mg/1	9	9	9	4	4	2	5.7	9
NO_3^-, mg/1	<1	<1	<1	<2.5	2.4	1.6	<1	.5
SO_4^{--}, mg/1							44	17
F^-, mg/1								1.2
DO, mg/1							8.3	
OXYGEN SATURATION, percent							91	

* High suspended solids in sample T were due to construction activity in the area.
** Analysis by U. S. Geological Survey.

U. S. Geological Survey Flow Data

During the period of sample collection the United States Geological Survey gauged the Red River at or near each major main stem sample station. The results of these measurements are presented in Table V-22. Station 4 is an official U. S. Geological Survey measuring station. The 41-year average annual discharge of the station is approximately 60 CFS. This compares with a flow of 26.3 CFS obtained during the survey and represents a flow higher than the average November flow at the station of 21.7 CFS[1/].

It can be seen from Table V-22 that the Red River flow approximately doubles between Stations 4 and 2. This is the contribution of Cabresto Creek, the fish hatchery effluent, and the numerous springs and seeps along the canyon between these stations.

TABLE V-22

RED RIVER FLOW DATA

(U.S. GEOLOGICAL SURVEY DETERMINATIONS)

STATION	DATE	FLOW (CFS)
#8	11-4-65	9.9
#7	11-4-65	16.3
#6	11-4-65	17.0*
#5	11-4-65	23.6
#4	11-4-65	26.3*
#3	11-4-65	31.8
#2	11-4-65	51.3*

*Average of 2 determinations

Water Quality

An appraisal of all water quality data indicates that the waters of the Red River are suitable for most beneficial uses. As a domestic water supply chlorination and filtration would be necessary. The river could serve as an industrial water supply for most users without treatment. A few of the more demanding users, i.e., food processing and steam generation, would require demineralization of the water prior to its use. The quality of the Red River water is acceptable as an irrigation supply. Low chlorides and relatively low solids content rank it superior to many other supplies. The existence of trout in the stream leaves little to be desired in regard to fishing and related recreational benefits of the river.

However, these favorable conditions are subject to reversal. Low flows on the order of 10-15 CFS are not uncommon, and this means that even small waste loads can effect the river. Marginal coliform loads emanating from the town of Red River and the fish hatchery would become significant with lower river flows.

Some idea of the assimilative powers of the river can be illustrated as follows:

With a flow of 15 CFS and a dissolved oxygen content of 8 mg/l the untreated domestic waste of approximately 10,000 people would interfere with the natural fish habitat of the area. With a flow of 15 CFS a discharge to the river of 24,000 pounds/day dissolved solids would raise the TDS of the river to the maximum recommended in the PHS drinking water standards. It appears certain that waste treatment must accompany any additional growth in the Red River Basin in order to preserve the high quality water now available.

As surveillance programs are initiated for the basin, those ground and surface water stations located below the tailings pond should have priority. These stations will show first any degradation in water quality due to industrial and irrigation activities in that area. As valley population increases, organic and bacterial pollution may become problematical, and surveillance of Stations 3 and 7 will become important. At all of the stations, surveillance of pH, DO, conductivity, and BOD will serve as an early warning of water degradation and the resulting loss of desirable fish habitat and usefulness of the water.

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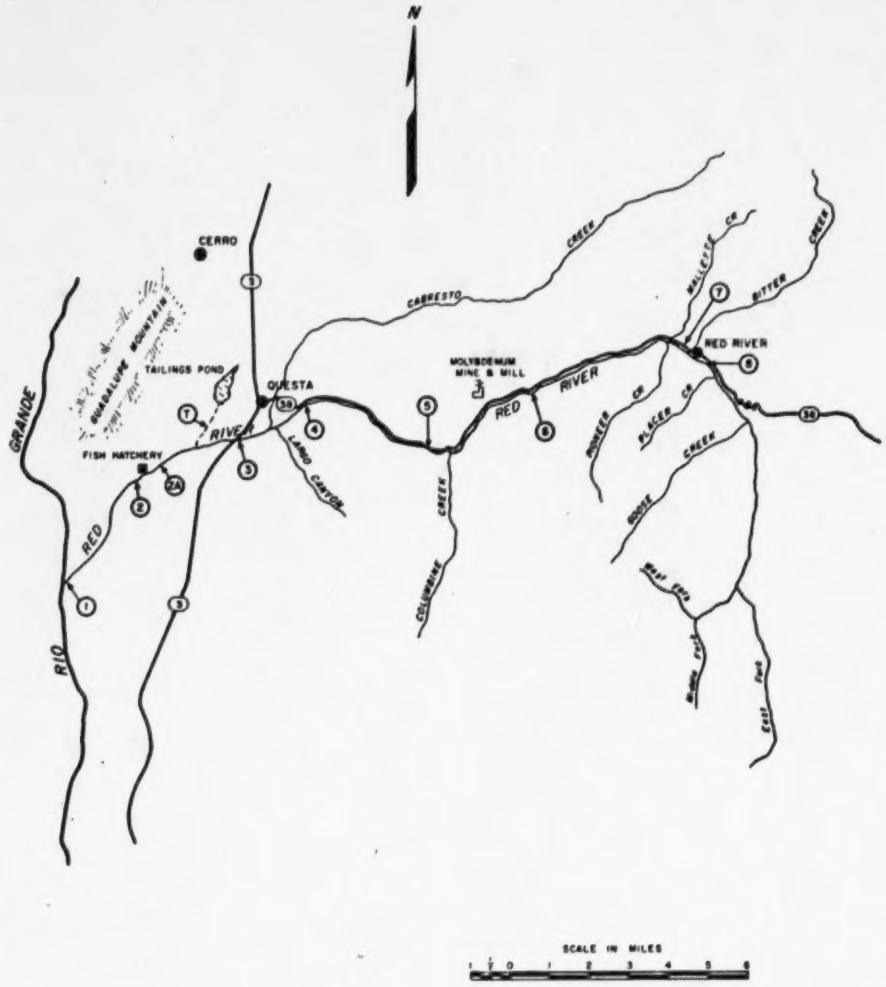

LEGEND

④ Major Sampling Stations

WATER QUALITY SURVEY
RED RIVER OF THE RIO GRANDE - NEW MEXICO

LOCATION MAP

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Federal Water Pollution Control Administration
ROBERT S. KERR WATER RESEARCH CENTER – ADA, OKLAHOMA

FIGURE III-1